ENERGY SAVINGS OPPORTUNITY SURVEY
DEWITT ARMY HOSPITAL
FORT BELVOIR, VIRGINIA

A/E CONTRACT NO.
DACA 31-89-C-0198

FINAL SUBMITTAL

VOLUME I

Executive Summary

AND

Engineering Study

Prepared for

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND

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VOLUME I
EXECUTIVE SUMMARY
AND
ENGINEERING STUDY

1.0 INTRODUCTION

Dewitt Army Hospital is a primary health care facility for Armed Forces personnel. It is located within the Fort Belvoir campus, about fifteen miles south of Washington, D.C. The facility provides out-patient services, including a pharmacy as well as in-patient services, both medical and surgical.

Energy Savings Opportunity Survey (ESOS) at Dewitt Army Hospital is a project to improve its energy utilization and includes analysis of applicable energy conservation opportunities (ECOs). This study was originally initiated by NUS Corporation under Contract No. DACA 31-84-C-0185 in 1985. In 1989, a pre-final report was submitted by NUS and reviewed by the Corps of Engineers, Baltimore District. At the end of 1989, after terminating NUS contract, the Corps of Engineers requested Engineering Applications Consultants, P.C. to make recommendations for editing the report. After a Scope of Work was developed, EAC was awarded a contract to review and edit this report. In the process of reviewing the NUS report, the following items were noted:

- The field survey was performed in 1985 and the pre-final report was submitted four years later in 1989.

- Comparison of 1989 baseline electrical consumption was made with 1982-84 metered data.

- Calculations for electrical savings used 11,600 btu/kWh for purchased electrical energy. (ECIP guidelines have a conversion factor of 3,413 btu/kWh for purchased power.)

- The baseline energy consumption indicated in NUS report is twice that calculated by EAC.

- The energy savings calculated manually by NUS for many ECOs differ by a factor of four from the computer calculated savings by EAC.

- The NUS report lists the use of distillate oil in lieu of residual oil which is used at the central boiler plant.

- The ECOs calculated by NUS do not take synergistic effects into account.

EAC's task has been to correct the above deficiencies as far as practicable. In editing this report EAC has performed the following functions:

- Revalidate field data and the calculations for baseline energy consumption.

- Recalculate the ECOs recommended by NUS for implementation by using computerized methods.

- Update the cost estimates and ECIP calculations of all ECOs included in NUS report.

- Make recommendations for programming projects.

In this report, the pre-final submittal prepared by NUS has been reviewed, updated or corrected and it constitutes a final submission for Energy Savings Opportunity Survey. This report includes recommendations for implementation of ECOs, project criteria and methodology for conducting this analysis. The review and editing of the report involved field visits for evaluating any changes to the building since the original survey was done and recalculating the recommended ECOs based on current energy prices and escalated costs.

Based on a total area of 210,260 square feet of space modeled the estimated total annual energy consumption of the building is 43,035 Mbtu. This yields a baseline energy usage of 204,679 btu/sq.ft/yr of site energy consumption. This compares unfavorably with 115,000

btu/sq.ft/yr of energy budget for a new hospital, and as a result demonstrates a potential for energy conservation.

A total of thirty-five (35) Energy Conservation Opportunities (ECOs) were evaluated in an attempt to reduce the energy consumption of this facility. Altogether, NUS had recommended fourteen ECOs for implementation. Nine of these ECOs were found to be not applicable, or economically feasible, therefore, they were deleted. One ECO, stand-by diesel generator, which was evaluated but not recommended by NUS was found to be feasible by EAC and has been recommended for implementation. In this report, altogether, seven ECOs have been recommended for implementation on the basis of their Savings-Investment-Ratio (SIR) being greater than one. The results of the energy and economic analysis of these seven ECOs are given below.

RECOMMENDED ECO'S PROJECT LIST

ECO #	DESCRIPTION	COST (incl. SIOH) $	FIRST YEAR DOLLAR SAVINGS $	ANNUAL ENERGY SAVINGS MBTU ELEC.	#6 OIL	TOTAL	$	SIR	SIMPLE PAYBACK PERIOD YEARS	PROGRAM YEAR	PROGRAM YEAR COST $
1-M1	Night Setback	7,382	37,429	563	3,411	3,974	37,429	62.64	0.19	1993	7,700
2-M2	Reduced SA & OA	83,550	58,728	1,485	4,063	5,548	49,523	8.19	1.35	1993	87,143
3-M3	MZ Demand Reset	11,610	7,312	42	483	525	5,074	7.31	1.51	1993	12,109
4-M4	Condensate Controls	4,654	2,562	---	257	257	2,562	6.97	1.73	1993	4,854
5-M5	Exhaust Air Heat Reclaim	23,338	7,791	83	649	732	6,972	4.05	2.85	1993	24,341
6-A1	Storm Windows	37,550	6,224	17	592	609	6,003	2.89	5.74	1993	39,165
7-E1	Standby Diesel Generator	30,378	6,436	171	(616)*	(445)	(3,539)	1.64	4.49	1993	31,684
	TOTAL	198,462	126,482	2,361	8,839	11,200	104,024	-	1.6	1993	$206,996

Legend for ECO - First digit represents priority, second and third characters/digits represent ECO numbers
SA = Supply Air
OA = Outside Air
MZ = Multi-zone
* = Diesel
SIR = Savings to investment ratio
MBTU = Million btu

Total construction cost of the feasible ECOs was estimated at $198,462, which when completed would result in an annual energy savings of 11,200 MBTU, with a first year cost saving of $126,482. This represents approximately 26% reduction in energy usage. The simple amortization period for the seven ECOs is 1.6 years.

Significant assistance and cooperation was provided by the Corps of Engineers and the facility for this analysis. EAC wishes to extend special appreciation to Mr. James Hawk, Project Manager, Baltimore District Corps of Engineers for his guidance which has contributed to the development of this study.

2.0 BUILDING DESCRIPTION

The main hospital building was built in 1953, which consists of wings "A", "B", and "C" which are five stories, wing "D" of 3 stories, and wing "E" of 2 stories, with a gross floor space of approximately 195,000 sq. ft. In 1975, a north addition was added. This basement and first floor addition has approximately 33,700 sq. ft. In the same year another basement and first floor addition of 10,800 sq. ft. was also built. This is called the south addition. The present total gross area is approximately 239,500 sq. ft. In 1975, a major renovation to the heating, ventilating, and air conditioning systems was also undertaken. During the past several years, the hospital has increased its outpatient services while reducing its long-term patient rooms.

The steam for heating the building and for ancillary services is supplied from the central heating plant at Fort Belvoir. The building has steam convertors and convectors, heating and ventilating units and reheat coils which provide space heating.

Cooling is provided by a number of air handling systems which are supplied with chilled water from two 350-ton centrifugal chillers located in the basement machine room. These chillers serve the entire building except the operating and recovery rooms, labor and nursery areas. The latter are served by three air-cooled chillers, one of them is a stand-by.

Two steam-to-water generators provide domestic hot water for service use in the building. The steam for these generators is supplied from the central heating plant.

The hospital's electrical system is served from two Virginia Power 22.9 kV feeders. This is stepped down to 2.4 kV at the hospital owned substation located east of the facility. An automatic transfer sequence for the substation main circuit breakers provides the capability for continuous operation of the hospital in the event of one feeder being de-energized.

3.0 PRESENT ENERGY CONSUMPTION

An analysis for an energy conservation project requires determination of existing energy-usage pattern. Ideally, such data can be obtained from the utility records for the building. However, the building does not have metered steam; the electric meters have been malfunctioning for a number of years and the data provided by them is inaccurate. As such, baseline energy consumption was established for space heating, space cooling, ventilation, domestic hot water and lighting, in accordance with TM 5-838-2 guidance. These calculations have been performed with the building data available for FY1991.

Based on a computer simulation, using Carrier's E20-II, Hourly Analysis Program (HAP), the annual energy usage for Dewitt Hospital has been determined to be about 204,679 btu/sq. ft., compared to 115,000 btu/sq. ft. for a new facility as per TM 5-838-2. This comparison demonstrates the potential for reducing existing energy consumption.

The following data is extracted from the computer simulation. The energy costs are based on the rates for FY1991.

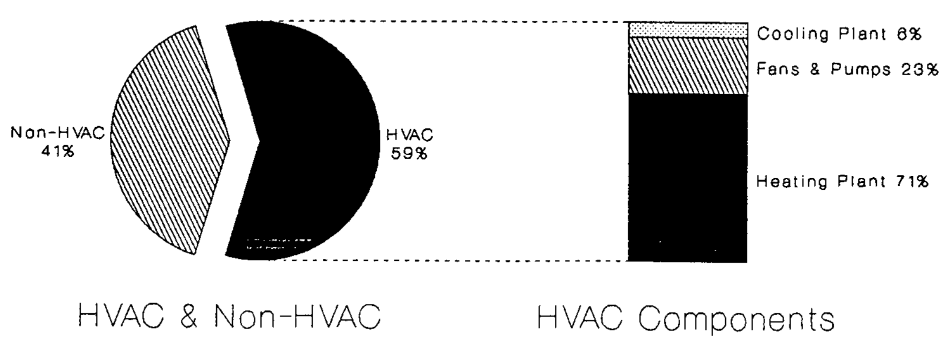
FUEL	SITE ENERGY MBTU/YR	SOURCE ENERGY MBTU/YR	COST $/YR
Electricity	15,920	15,920*	209,281+
Residual Fuel (#6 Oil)	27,115	36,334**	270,336++
Total	43,035	52,254	479,617

* Based on ECIP guidance of 25 April 1988 (Purchased Electric Power)
** Based on site energy conversion of 1,000 btu/lb. (TM 5-838-2) and source energy conversion of 1,340 btu/lb. (ECIP guidance)
\+ Includes demand charges
++ Based on Post-supplied rate of $9.97/1000 lb. of steam charged to consuming facilities.

By system component, the energy usage is as under:

BUILDING SYSTEM	SITE ENERGY BY FUEL TYPE (MBTU)/YR	
	#6 OIL	ELECTRICITY
Cooling Plant	---	1,864
Heating Plant	21,170	---
Air Systems	---	6,126
Pumps	---	864
Lights	---	4,312
Domestic Hot Water	5,945	---
Miscellaneous Electric	---	2,754
TOTAL	27,115	15,920

Baseline Energy Usage



4.0 RECOMMENDED ECOs

Based on a review of building drawings, field observations and interviews with the operating personnel, the following ECOs have been found to be economically feasible and are recommended for implementation:

Mechanical:

ECO-1-M1 - Night Setback: Provide time clock controls for night setback in North and South additions and basement general area.

ECO-2-M2 - Reduce Supply Air and Outside Air: Reduce supply air and outside air quantities[1] in 17 zones.

ECO-3-M3 - Multi-zone Unit Demand Reset: Provide controls on multi-zone units, serving North and South additions, to reset hot and cold deck temperatures based on zone calling for greater demand.

ECO-4-M4 - Add Controls to Eliminate Wastage of Condensate: Replace controls for the steam condensate used for pre-heating domestic hot water system.

ECO-5-M5 - Exhaust Air Heat Reclaim: Recover heat from exhaust of air-handling unit serving the critical areas.

Architectural:

ECO-1-A1 - Storm Windows: Provide storm sashes to windows which do not have storm windows (about one-third of all windows).

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[1] Conforming to TM 5-838-2 Army Health Facility Design, June 1990

Electrical

ECO-7-E1 - Diesel Generator: Two existing 350 kW diesel generators feed a switchboard to meet emergency loads in the building. Two options were investigated to utilize these generators:

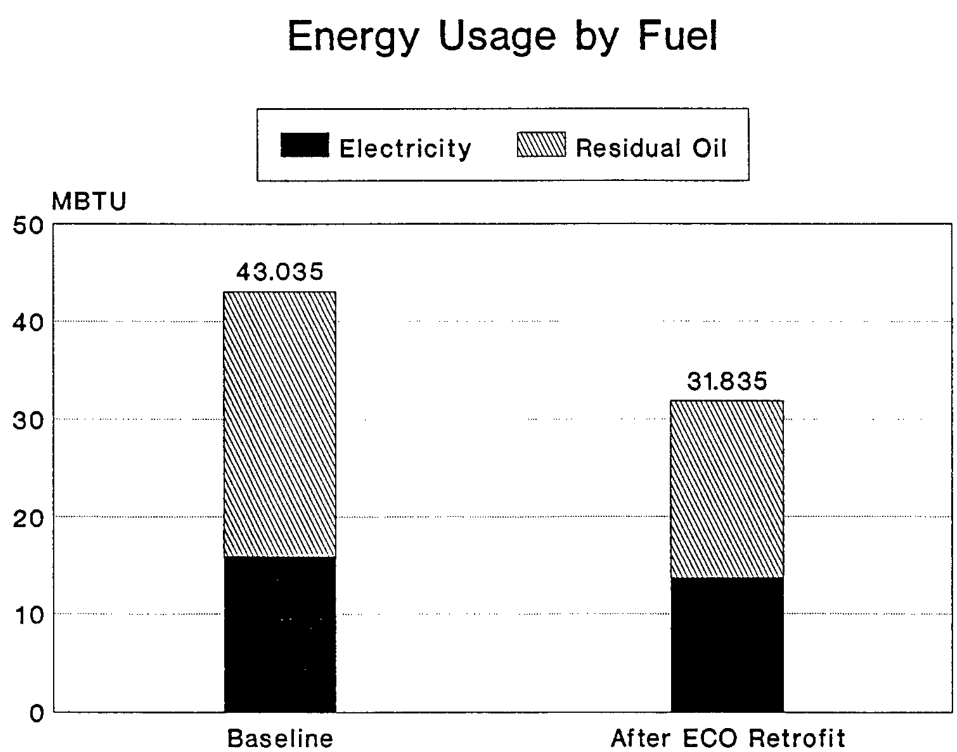
> Under the recommended Option (Option B), Fort Belvoir will participate in the utility company's incentive program (See Virginia Power Schedule MSSG). The generators will be put on a standby status to be brought on line when the utility company requests their operation in accordance with the terms of the schedule.

The feasibility of the above ECOs was determined on the basis of calculations for energy savings (taking into account synergistic effects), investment cost estimates and life cycle cost analysis. Savings to investment ratio (SIR) of unity, or greater, for an ECO qualifies it for implementation. The table on page 3 lists the recommended ECOs in descending order of savings to investment ratio (SIR), with their associated construction cost, energy savings in MBTU, dollars, and payback period, among other items.

5.0 ENERGY AND COST SAVINGS

The following table presents the estimated energy usage patterns and costs before and after the implementation of the recommended ECOs. The energy and its cost are based on FY1991 data.

Item	Existing Energy & Cost	Energy and Cost After Implementation of ECOs	Savings After Implementation	
			%	Savings
Source Energy Consumption				
Electricity MBtu	15,920	13,559	14.8	2,361
Residual Fuel (#6 Oil) MBtu	36,334	24,490	32.6	11,844
Total MBtu	52,254	38,049	27.2	14,205
Site Energy Consumption				
Total MBtu	43,035	31,835	26.0	11,200
Btu/SF - year	204,679	151,408	26.0	53,271
Energy Costs				
$/year	479,617	353,135	26.4	126,482
$/SF - year	2.28	1.68	26.4	0.60



6.0 PROJECT CRITERIA

The analyses of the building energy usage and the estimated reduction in the energy usage due to the implementation of the EAC-proposed energy conservation opportunities are based on criteria set forth here.

6.1 Outdoor Conditions

Based on publication TM 5-785 Engineering Weather Data, the following outdoor conditions have been assumed:

Summer	90°F DB/75°F WB
Winter	12°F

6.2 Indoor Conditions

Based on publication TM 5-838-2 Army Health Facility Design, June 1990, the following indoor conditions have been used:

	Most Areas	Critical Areas
Summer	78°F	75°F
Winter	70°F	75°F

The primary activity in an area or a zone dictated the choice of indoor conditions for simulation. The hours of operation and occupancy levels are based on the NUS report and on information obtained from the facility.

6.3 Fuel Rates

Fuel rates for the analysis have been obtained from the Fort Belvoir Facilities Division. These rates are current rates for FY1991.

6.3.1 Electricity

For electricity, Virginia Power's Schedule MS for Federal Government installations has been used, with the additional input of -$0.00093/kWh as fuel adjustment factor (effective since April, 1990). For Federal Government installations, Virginia Power also offers an incentive program, Schedule MSSG. This program provides credit for on-site generation of electric power when requested by the power company. The credit is $6.00/month for each kW of electricity generated. The participant is notified no less than four hours prior to the requested generator operation. The operation of generators is not required more than once per day, 125 hours per season or 200 hours per year.

6.3.2 Other Rates

Based on the recent data available from the facility, the following factors have been used for the calculations:

Item		Factor	Source
Rate Charged by Central Plant	=	$9.97/1000 lb. of steam	Base Facilities
For Site Energy Conversion Factor	=	1,000 btu/lb.	TM 5-838-2
Source Energy Conversion Factor	=	1,340 btu/lb.	ECIP Guidance

6.4 Construction Costs

The costs of implementing ECOs are taken from the NUS report. These have been escalated to current cost based on building cost index published in Engineering News Review (ENR) of December 24, 1990, i.e., 2719, which gives an escalation factor of 1.116 compared to September 1985 index of 2446.

For the ECOs recommended by EAC, or where the existing cost did not reflect the cost of installation appropriately, new cost estimates have been developed.

6.5 Economic Life

As stipulated in the Energy Conservation Investment Program (ECIP) guidelines, economic lives have been based on the lesser of 25 years or the useful life of the ECO. The remaining life of the hospital is assumed to exceed 25 years.

6.6 Discount Factors

The Uniform Present Worth (UPW) factors published for Region 3 by the Department of Energy (DOE) under the Federal Energy Management Program (FEMP), November 1988 issue have been used in accordance with the guidance for the Energy Engineering Analysis Program (EEAP). A discount rate of 7% has been used in conformance with ECIP guidelines.

7.0 BUILDING COMPONENTS AND SYSTEMS

7.1 Architectural

The main hospital building was built in 1953, which consists of wings "A", "B", and "C" which are five stories, wing "D" of 3 stories, and wing "E" of 2 stories, with a gross floor space of approximately 195,000 sq. ft. In 1975, a north addition of approximately 33,700 sq. ft. was added. This basement and first floor addition has approximately 33,700 sq. ft. In the same year another basement and first floor addition of 10,800 sq. ft. was also built. This is called the south addition. The total gross area is approximately 239,500 sq. ft. In 1975, a major renovation to the heating, ventilating, and air conditioning systems was also undertaken. During the past several years, the hospital has increased its outpatient services while reducing its long-term patient rooms.

7.1.1 Building Envelope

The original wall construction is mainly uninsulated concrete with single pane glass windows. Storm windows were added during the 1975 renovation. However, during field investigation, no storm sashes were found on a large number of windows at the basement and first floor levels. The walls of the north and south additions are constructed of insulated wall panels and 1/4" polished glass windows.

7.1.2 Walls

The main building walls are uninsulated; however, Wing D has some insulation in its walls.

Main Building	Wing D
1. 8" Concrete	1. 8" Concrete
2. 3" Non-Reflective Air	2. 2" Insulation
3. GYP Wall Board	3. 3" Non-Reflective Air
	4. 1" GYP Wall Board

North and south wing walls are constructed with insulated wall panels and 1/4" polished glass windows.

7.1.3 Roof

Main Building	North and South Wing
1. Roofing	1. Built-up Roof
2. 2" Insulation	2. Roof Insulation Thickness 2"
3. Fill	3. Metal Deck
4. Non-Reflective Air	4. Non-Reflective Air
5. Acoustical Tile	5. Acoustical Tile

7.2 Mechanical

7.2.1 Primary Heating System

High pressure steam is supplied to the hospital from the central heating plant at Fort Belvoir. At pressure reducing stations, 100 psi steam is reduced in two stages to medium pressure steam (60 psi) for process, and low pressure steam (12 psi) for heating.

7.2.2 Secondary Heating System

Steam convectors provide heating to the majority of the patient rooms and were installed at the time of original construction. Each exposure has a steam control valve with outside air thermostat to control steam quantity, balancing for each convector is provided by a manual control valve. Air handling units have steam heating coils.

Heating is provided by hot water fin tube radiation and is zoned by building exposure in the north and south addition. Hot water is also supplied to heating coils in AC-1, 2, and 3 from steam to water convertor pump sets. Zone thermostats control circulating pumps, and supply water temperature is reset by outdoor air thermostat.

7.2.3 Primary Cooling System

The central chilled water system includes two 350-ton hermetic centrifugal chillers located in the basement machine room, two cooling towers located on site and associated chilled water and condenser water pumps. This system serves the entire building except the critical areas such as operating rooms, recovery room and labor and delivery rooms. The chillers are in operation from April to November. During winter, the system is deactivated and the cooling towers are drained. Most of the time, one chiller is sufficient to handle the building load, and only in extreme hot weather the second chiller is activated. Four chilled water pumps circulate chilled water to the various cooling coils in the building. The pumps are manually started and stopped by the operating engineer in order to maintain chilled water flow requirement.

7.2.4 Critical Area Cooling System

Critical area consists of operating, recovery, labor, and delivery rooms. The cooling source for these areas are three air-cooled chillers, with one chiller as stand-by. This system operates 24 hours a day, 365 days a year. Three-way valves control chilled water coils.

Chilled water pumps (one stand-by) located in the penthouse machine room circulate the chilled water from the chiller to the cooling coils in the air-handling units. Since no pre-heat coils are provided, the chilled water pumps run continuously to prevent freeze-up during cold weather. Due to this reason, the economizer cycle operation of these air handlers has been de-activated.

7.3 Electrical

The hospital's electrical system is served from two Virginia Power 22.9 kV feeders. This is stepped down to 2.4 kV at the hospital owned substation located east of the facility. An automatic transfer switch for the substation main circuit breakers provides the capability for continuous operation of the hospital in the event of one feeder being de-energized. Lighting in the building is mostly by fluorescent fixtures except in some areas where incandescent lighting is still used. The replacement lamps for fluorescent fixtures are energy-efficient 34-watt lamps and about eighty percent of fluorescent fixtures already have the new energy-efficient lamps.

8.0 METHODOLOGY

The objective of this analysis is to update the work done under an earlier contract. However, EAC undertook a field survey of the energy-expending equipment to identify any changes that might have taken place since the original survey was done over five years ago. This opportunity was also utilized to have discussions with the building engineers to ascertain building operation and usage characteristics. The data collected was utilized to simulate baseline energy consumption. Under guidance of the Baltimore District Corps of Engineers, the ECOs found feasible and recommended by NUS Corporation were re-evaluated in the light of new field surveys.

8.1 Baseline Computer Simulation

Carrier's computer software E20-II, Hourly Analysis Program (HAP) was used to model the facility, simulate its energy consumption patterns and energy savings for each of the ECOs. The input data was obtained from the previous report and the recent field survey.

The building was divided into 20 zones for analysis purposes. Zoning was determined on the basis of the natural boundaries of the space, such as various levels, wings and wall and partition separation, as-well-as by the type of operation, hours of operation and the HVAC system serving the zone. Data for each zone was then input to the computer and on the basis of schedules input into the program, baseline energy consumption was determined.

8.1.1 Zonal Characteristic Data

The zonal characteristic data input for computer simulation is included in Volume II.

8.1.2 General Assumptions

The following general assumptions were made for the computer simulation for performing energy-consumption analysis. Assumptions specific to ECOs are described where appropriate:

- U-values for the walls and roof systems, as obtained from NUS report are:

Walls	Btu/h-sq.ft.-°F
Main Building	0.568
Building 'D'	0.156
North and South Addition	0.102
Roof	
Main Building	0.097
North and South Addition	0.104

- Holidays were considered to have the same characteristic load as Sundays.

- Schedules for various loads like lighting, people, and heat producing equipment were based on field observations, interviews with the operating personnel and common practice in the industry.

- Plant data has been obtained from field observations and manufacturer's catalogs.

- Based on the interviews with operating personnel none of the building zones has night set-back in operation.

- Indoor design temperatures are based on TM 5-838-2, Army Health Facility Design, June 1990.

- Outdoor design temperatures are based on TM 5-785, Engineering Weather Data, as under:

Summer:	90°F DB/75°F, WB
Winter:	12°F DB

- The infiltration rate has been calculated based on ASHRAE 1989, Fundamentals.

- Based on TM 5-838-2 guidance, only the energy required for space heating, space cooling, ventilation, domestic hot water and lighting has been simulated.

8.2 Computer Simulation of ECOs

As indicated earlier, the baseline energy consumption was simulated utilizing Carrier's E20-II, Hourly Analysis Program (HAP). The effect of implementing each ECO on energy consumption was determined by modifying the affected system and resimulating the building energy usage. The hourly analysis done by the program provides an accurate representation of an ECO's contribution to energy savings and incidental energy or non-energy cost reductions, e.g., electric demand. Most of the mechanical and architectural ECOs were analyzed by the computer program HAP. The electrical ECOs, namely, diesel generator, occupancy sensors, time clock controls, were analyzed by using a spreadsheet program developed by EAC.

8.2.1 Electric Demand

The utility company serving the base has a complex formula for determining electric charges payable, including demand charges. The demand charges are based on 90% of the highest kW of demand during the months of June through September of the preceding eleven billing months. For simulation, it was assumed that any reduction in demand (kW) will affect the total billing for the base, in accordance with the above clause.

8.3 Diesel Generators

Two 350 kW diesel generators feed a switchboard to meet emergency loads in the building. Loads served from the switchboard consist of general lighting, miscellaneous equipment and motors serving the critical care area, along with fire pump and elevators. Two options were conceptualized for analysis:

Option A - There are two strategies. Under the first strategy, the existing emergency loads connected to the generators will be served by these generators during the peak load hours between approximately 12 noon and 3:00 p.m. to shave off peak demand and thus reduce demand charges year round. As an extension of the above, under the second strategy, in addition to the emergency loads, other motor loads, will be served by the generators during the peak load hours to shave off peak demand to reduce costs throughout the year. The second strategy has the potential for greater peak-shaving and hence larger savings. However, if due to any unique weather condition or other contingency, peak load occurs during any other period, the savings will be jeopardized. In order to avoid such an eventuality, it is recommended that the power company install contact closures at the demand meters to monitor the load. By reactivating, or installing EMCS, the generators will be triggered when EMCS

monitors load reaching a pre-determined kW level. This will be more responsive to the needs, both functional and economical, of the facility.

Option B - This option involves the operation of the generators on a stand-by basis in contrast with Option A, under which it is run during known peak load hours. This option will require Fort Belvoir's participation in Virginia Power's standby generation program, under Schedule MSSG for large Federal government installations. The program, in summary, allows a monthly credit of $6.00/kW of applicable contracted generation. The participant is notified no less than 4 hours prior to the requested generator operation. The operation of the generators will not exceed once per day, 125 hours per season or 200 hours per year. The detailed schedule is included in the appendices to this volume.

Both Options A and B envisage utilizing existing transfer switches which will cause momentary power interruption to all areas and equipment connected to the transfer switches. To eliminate this problem, closed transient type transfer switches can be installed. However, cost, in range of $200,000 to $250,000, will disqualify these options from economic feasibility point of view.

8.4 Effect of Synergy on Analysis

The computer simulation data for estimated energy savings and the estimated costs were used to determine preliminary savings-to-investment ratios (SIRs) for each ECO. These ratios were used to prioritize the qualifying ECOs, based on SIR being unity or greater.

In order to analyze the effects of synergy, the simulation of energy usage with an ECO was used to simulate building energy with ECO next lower on the priority scale. This had the

effect of generating new SIRs which changed the ECOs' order. This process was repeated successively until the order of ECOs was established in descending order of SIRs.

9.0 ENERGY CONSERVATION OPPORTUNITIES (ECOs)

9.1 ECOs Investigated

All architectural, mechanical, and electrical energy conservation opportunities (ECOs) investigated by NUS were reviewed and their cost estimates updated. The ECOs recommended by NUS for implementation were further subjected to detailed field investigation, interviews with the building operating personnel, and technical and economic feasibility. Following is a brief description of ECOs evaluated by NUS Corporation:

Architectural:

ECO-A1 - Storm Windows: Provide storm sashes to windows which do not have storm windows (about one-third of all windows).

ECO-A2 - Add insulation to walls of main building constructed in 1953. The walls did not include insulation.

ECO-A3 - Caulk and weatherstrip windows and doors.

ECO-A4 - Insulate the ceilings located above steam "PRV" stations.

ECO-A5 - Add roof insulation sufficient to provide conformance with DOD criteria.

Mechanical:

ECO-M1 - Night Setback: Provide clock controls to implement unoccupied mode temperatures and outside air damper controls. These controls shall be provided on the four air-

conditioning and heating units serving the North addition, the South additions, and general services in the basement area.

ECO-M2 - Reduced Outside Air and Supply Air Quantities: Most of the hospital zones are presently supplied with outdoor air and supply air quantities far in excess of the Guidelines for Construction and Equipment of Hospital and Medical Facilities, U.S. Department of Health and Services. The supply air and outdoor air flows will be adjusted to the recommended levels. This will be achieved by resetting automatic outside air, return air and exhaust air dampers, adjusting the corresponding fans, registers and grilles and by replacing fan motor pulleys and belts.

ECO-M3 - Multi-Zone Units Demand Reset: Provide energy-conserving pneumatic optimization relays for the air-conditioning units AC-1 and AC-3 serving the North addition perimeter zone and the South addition. The zone demanding the most heating or most cooling will cause the controls to reset. A pneumatic submaster thermostat shall be provided for each hot deck valve and a 3-way control valve shall be added to each unit's cooling coil.

ECO-M4 - Controls to Eliminate Condensate Wastage: Install low pressure steam valves and immersion thermostats for each of the two storage tanks, so that steam can be shut off automatically when the stored water attains the pre-determined temperature.

ECO-M5 - Exhaust Air Reclaim: Install run-around heat recovery system to reclaim heat from the exhaust fan (EF-5) for surgical area and preheat the outdoor air to the large air handling unit (Blower-17) supplying outside air to many areas.

ECO-M6 - Retrofit a variable frequency modulator for capacity reduction on the existing chillers in lieu of the less energy efficient vane control. (Note: This retrofit was not recommended by the chiller manufacturer.)

ECO-M7 - Chilled Water Distribution Modification: Convert the chilled water distribution system from constant flow to variable flow utilizing primary and secondary pumping. This may be accomplished by some repiping in central plant, adding pumps and closing off the normally open port of the 3-way control valves.

ECO-M8 - Chilled Water Reset: Install a system of sensors and controllers that will allow resetting of chilled water supply temperature as high as possible without loss of proper dehumidification. (NOTE: This is currently being implemented manually.)

ECO-M9 - Two-Speed Motor on Cooling Towers: Provide two-speed motors to allow the plant to reduce fan energy costs during off-peak conditions.

ECO-M10 - Lower Condenser Water Temperature: Revise the cooling tower and condenser water control to maintain 65°F. (NOTE: This is currently being done.)

ECO-M11 - Revise Steam Heating System: Replace the existing steam perimeter heating system installed in the original 1953 building with a new hot water perimeter system. The existing system is controlled by outside air temperature, causes uneven temperatures, thus utilizing energy inefficiently.

ECO-M12 - Convert Patient Room Systems: Replace existing constant volume systems serving patient floors with VAV systems.

ECO-M13 - Reactivate Economizer Cycle on AHU-10 and 11: AHUs 10 and 11 were installed with economizer cycle capabilities, but in the absence of preheat coils, chilled-water coil freezes up. Installation of preheat coils will obviate this problem and economizer cycles can be reactivated.

ECO-M14 - VAV Conversion: Replace the existing constant volume reheat air handling system, serving the first floor outpatient area, with new VAV system.

ECO-M15 - Enthalpy Control: On all systems equipped with economizer cycle controls, provide enthalpy controllers to determine periods of economizer cycle operation in lieu of the existing outdoor air thermostat. (NOTE: This type of control is not permissible as per Army policy.)

ECO-M16 - Heat Trace Domestic Hot Water Piping: The domestic hot water system constantly recirculates quantities of water to prevent a time lapse of hot water availability to the user. In new construction, this ECO is feasible, whereas in an existing building where pipes, etc. are run in walls, it is not feasible.

ECO-M17 - Water Treatment: The condenser water system water treatment has been deactivated. Provide automatic monitoring and controlled feed water treatment system for the cooling towers. This will reduce tube fouling and improve heat transfer capabilities of the chillers. (NOTE: This is currently being done.)

ECO-M18 - Insulate Tank: Provide insulation on all hot water storage tanks. (NOTE: Insulation exists on hot water storage tanks.)

ECO-M19 - Modify Condenser Water Distribution: Provide 2-position remotely controlled butterfly valves to isolate cooling tower sections during off-peak periods.

ECO-M20 - Dead Band Controls: Provide a dead band type thermostat and modify existing controls on AHUs 6 & 7 coils to eliminate simultaneous heating and cooling.

Electrical

ECO-E1 - Diesel Generator: Two 350 kW diesel generators feed a switchboard to meet emergency loads in the building. Two options were investigated to utilize these generators:

Option A - Based on the generator capacity, additional loads will be connected to this switchboard. The generator will be run during the peak load hours to shave off demand (kW). However, if due to any unique weather condition or other contingency, peak load occurs during any period other than anticipated peak hours, the savings will be jeopardized.

Option B - Fort Belvoir will participate in the utility company's incentive program (See Virginia Power Schedule MSSG). The generators will be put on a standby status to be brought on line when the utility company requests their operation in accordance with the terms of the schedule.

ECO-E2 - Occupancy Sensors: Occupancy sensors can be installed in the ceilings of the public corridors. These sensors would help turn off the lighting fixtures during non-essential hours. Occupancy sensors would be most beneficial during night hours when general illumination will not be required, except for late night nurses' calls - and follow-up.

ECO-E3 - Time Clocks: The existing lighting fixtures are controlled from the local switches located in either the nurses' station or respective corridors. Most of these fixtures remain on all the time. Time clocks can be wall mounted in the nurses' station to control these lights. Prior to the installation of the time clocks, some of the lighting circuits will have to be modified. Under existing conditions, no uniform night lighting fixtures exist. Some corridors have an adequate number of night lighting fixtures and some corridors have none. Lighting in such areas will be modified.

ECO-E4 - Replace Existing Incandescent Lamps with Energy Efficient 34 Watt Fluorescent Lamps: The existing main hospital building is lighted using incandescent fixtures in some areas. Most incandescent lamps presently used in the hospital are either 100 watts or 150 watts. To obtain the same relative lighting levels using fluorescent lamps, the savings in watts per fixture would be approximately 32 watts for the 100 watt fixtures and approximately 65 watts for the 150 watt fixtures. (Approximately 80% of fixtures have already been retrofitted.)

ECO-E5 - Replace Standard Ballasts with Energy Saving Ballasts: The existing fluorescent lighting fixtures are equipped with standard ballasts. Energy saving ballasts for fluorescent fixtures containing two lamps can save an additional 10 percent over and above the savings obtained using reduced wattage lamps.

ECO-E6 - Infrared Switching of Lighting Fixtures: Recent studies of office building occupancies have indicated that offices and similar use areas are unoccupied for over 50 percent of the working day. An infrared sensor lighting control system provides lighting in an area only when the area is occupied. Lighting control of this type can be used to control fixtures in individual offices or in small areas of large open offices.

ECO-E7 - Photocell Control of Lighting Fixtures: During daylight hours the lighting levels in many offices are high and room lighting adds little to the room lighting level. Using photocell control, dimming the lighting fixture or turning off the lighting fixture is possible. Another use of photocell fixture control would be for control of perimeter lighting in large open office areas.

ECO-E8 - Energy Efficient Motors: The replacement of the existing electric motors with motors having a higher efficiency can provide a substantial electric cost savings.

ECO-E9 - Power Factor Improvement: Power factor records for the Hospital facility are not maintained. However, an overall base power factor record is available from the utility company. The utility company records indicate that the base power factor varies from approximately 96 percent during periods of low electrical usage to 90 percent during periods of higher usage. Capacitors have been installed on the base distribution circuits for the base power factor improvement.

ECO-E10 - Controlled Elevator Operation: A relatively substantial amount of the facility energy budget is needed for operation of the elevators due to the large elevator motor horsepower and the frequent starting required for this type of motor. (NOTE: This is being implemented.)

9.2 Computer Simulation of ECOs

As indicated earlier, the baseline energy consumption was simulated utilizing Carrier's E20-II, Hourly Analysis Program (HAP). The effect of implementing each ECO on energy consumption was determined by modifying the affected system and resimulating the building energy usage. The hourly analysis done by the program provides an accurate representation of an ECO's contribution to energy savings and incidental energy or non-energy cost reductions, e.g., electric demand. Most of the mechanical and architectural ECOs were analyzed by the computer program, HAP. The electrical ECOs, namely, diesel generator, occupancy sensors, time clock controls, were analyzed by using a spreadsheet program developed by EAC.

9.3 Analysis of ECOs

The following table summarizes the results of updating the analysis of all ECOs investigated in terms of FY 1991 costs. These ECOs were originally investigated by NUS.

ECO #	ECO DESCRIPTION	ANNUAL ENERGY SAVING (MBTU)	COST (INCLUDING SIOH) $	SIR	REMARKS
<u>Architectural</u>					
A-1	Storm Windows	609	37,550	2.89	Recommended
A-2	Wall Insulation	113	44,795	0.44	Does not qualify
A-3	Caulking & Weatherstripping	227	35,332	0.29	Does not qualify
A-4	Ceiling Insulation	8	23,922	0.02	Does not qualify
A-5	Roof Insulation	700	453,497	0.25	Does not qualify
<u>Mechanical</u>					
M-1	Night Setback	3,974	7,382	62.64	Recommended
M-2	Reduced O.A. and S.A.	5,548	83,550	8.19	Recommended
M-3	MZ Unit Demand Reset	525	11,610	7.31	Recommended
M-4	Controls to Eliminate Condensate Wastage	257	4,654	6.97	Recommended
M-5	Exhaust Air Reclaim	732	23,338	4.05	Recommended
M-6	Variable Frequency Modulator	---	---	---	Not recommended by manufacturer
M-7	Chilled Water Distribution Mod.	412	32,837	0.70	Does not qualify
M-8	Chilled Water Reset	---	---	---	Being implemented manually
M-9	Two-speed Motor on Cooling Towers	48	11,962	0.23	Does not qualify
M-10	Lower Condenser Water Temperature	---	---	---	Being implemented manually
M-11	Revise Steam Heating System	300	310,541	0.25	Does not qualify
M-12	VAV Systems for Patient Rooms	1,837	541,571	0.35	Does not qualify
M-13	Reactivate Economizer Cycles	137	14,941	0.51	Does not qualify
M-14	VAV for OPD	1,428	230,146	0.89	Does not qualify
M-15	Enthalpy Control	---	---	---	Not permissible

ECO #	ECO DESCRIPTION	ANNUAL ENERGY SAVING (MBTU)	COST (INCLUDING SIOH) $	SIR	REMARKS
M-16	Heat Trace CHW	---	---	---	Not feasible; pipes inaccessible
M-17	Water Treatment	---	---	---	Currently being done
M-18	Insulation for Hot Water Storage Tanks	---	---	---	Insulation exists
M-19	Condenser Water Distribution Mod.	160	14,542	0.61	Does not qualify
M-20	Dead Band Controls	10	1,326	0.86	Does not qualify
Electrical					
E-1	Diesel Generator - Option A - Option B	 (1,151) (445)	 30,378 30,378	 10.15 1.64	 Not recommended, see text Recommended
E-2	Occupancy Sensors	73	17,693	(0.44)	Does not qualify; ECIP Criteria
E-3	Time Clocks	152	46,918	(0.37)	Does not qualify; ECIP Criteria
E-4	Replace Incandescent Lamps with Fluorescent	1,137	89,955	0.42	Does not qualify; ECIP Criteria
E-5	Energy Saving Ballasts	53	65,556	0.06	Does not qualify; ECIP Criteria
E-6	Infra-red Controls	427	20,289	0.71	Does not qualify, ECIP Criteria
E-7	Photocell Controls	136	8,092	0.46	Does not qualify
E-8	Energy Efficient Motors	629	54,474	0.66	Does not qualify
E-9	Power Factor Improvement	---	---	---	No further improvement feasible
E-10	Controlled Elevator Operation	---	---	---	Being currently done

9.4 Results of Analysis of ECOs

The table on the next page summarizes the energy and cost data of the ECOs recommended by EAC.

RECOMMENDED ECO'S PROJECT LIST

ECO #	DESCRIPTION	COST (incl. SIOH)	FIRST YEAR DOLLAR SAVINGS	ANNUAL ENERGY SAVINGS				SIR	SIMPLE PAYBACK PERIOD	PROGRAM YEAR	PROGRAM YEAR COST
				MBTU							
		$	$	ELEC.	#6 OIL	TOTAL	$		YEARS		$
1-M1	Night Setback	7,382	37,429	563	3,411	3,974	37,429	62.64	0.19	1993	7,700
2-M2	Reduced SA & OA	83,550	58,728	1,485	4,063	5,548	49,523	8.19	1.35	1993	87,143
3-M3	MZ Demand Reset	11,610	7,312	42	483	525	5,074	7.31	1.51	1993	12,109
4-M4	Condensate Controls	4,654	2,562	---	257	257	2,562	6.97	1.73	1993	4,854
5-M5	Exhaust Air Heat Reclaim	23,338	7,791	83	649	732	6,972	4.05	2.85	1993	24,341
6-A1	Storm Windows	37,550	6,224	17	592	609	6,003	2.89	5.74	1993	39,165
7-E1	Standby Diesel Generator	30,378	6,436	171	(616)*	(445)	(3,539)	1.64	4.49	1993	31,684
	TOTAL	198,462	126,482	2,361	8,839	11,200	104,024	-	1.6	1993	$206,996

Legend for ECO - First digit represents priority, second and third characters/digits represent ECO numbers

SA = Supply Air
OA = Outside Air
MZ = Multi-zone
* = Diesel
SIR = Savings to investment ratio
MBTU = Million btu

10.0 ENERGY PLAN

The projects that do not qualify for ECIP, i.e., projects costing less than $200,000 fall into the category of Productivity Capital Investment Programs (PCIP). The following categories of PCIP programs are available for the recommended ECOs:

1. Quick Return in Investment Program (QRIP): This program is for projects which have a total cost of less than $100,000 and a simple payback period of two years or less. Three year procurement (AMMO and OPA) appropriations are available for this program.

2. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a cost greater than $100,000 and simple payback period of four years or less. The projects under this program require MCA funding.

3. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a cost greater than $100,000 and a simple payback period of four years or less. Projects under this program must be pre-identified two fiscal years in advance.

Considering the above programs, the following options are available:

1. **QRIP** - Prepare two packages as follows:

Project No. 1

ECO #	Description	Cost (incl. SIOH)	
		1991	Program Year 1993
ECO #1 - M1	Night Setback	$7,382	$ 7,700
ECO #2 - M2	Reduce Supply Air and Outdoor Air Quantities	$83,550	$87,143
	TOTAL	$90,932	$94,843

Project No. 2

ECO #	Description	Cost (incl. SIOH)	
		1991	Program Year 1993
ECO #3 - M3	Multi-Zone Demand Reset	$11,610	$12,109
ECO #4 - M4	Condensate Controls	$4,654	$4,854
ECO #5 - M5	Exhaust Air Heat Reclaim	$23,338	$24,342
	TOTAL	$39,602	$41,305

ECO #6-A1 and 7-E1 will not qualify under this program.

2. **OSD-PIF**: Under this option, all seven recommended ECOs could be packaged together as one project, i.e.,

ECO #	Description	Cost (incl. SIOH)	
		1991	Program Year 1993
ECO #1-M1	Night Setback	$ 7,382	$ 7,700
ECO #2-M2	Reduce Supply Air and Outside Air Quantities	$ 83,550	$ 87,143
ECO #3-M3	Multi-zone Demand Reset	$ 11,610	$ 12,109
ECO #4-M4	Condensate Controls	$ 4,654	$ 4,854
ECO #5-M5	Exhaust Air Heat Reclaim	$ 23,338	$ 24,342
ECO #6-A1	Storm Windows	$ 37,550	$ 39,165
ECO #7-E1	Standby Diesel Generator	$ 30,378	$ 31,684
	TOTAL	$198,462	$206,997

3. **PECIP:** All seven recommended ECOs would qualify under this program. The project must be identified two fiscal years in advance.

11.0 GENERAL ASSESSMENT OF BUILDING SYSTEMS

The original building and its associated mechanical and electrical systems are approximately forty years old. The mechanical and electrical systems have provided service well beyond their useful life. These systems are suffering from obsolescence, inadequate maintenance and disrepair due to unavailability of spare parts. Some of the items that merit attention are as follows:

a. There are numerous leaks in the steam piping. These are causing safety hazard as well as wasting energy. The steam piping should either be repaired or replaced.

b. In the patient rooms, the valves at the convectors are malfunctioning and obtaining replacement parts is difficult due to the age of the system. In addition, the convectors have limited controls. For example, in one instance, four floors are controlled by one thermostat. This is causing overheating and wasting energy. The air conditioning in the patient rooms is provided by horizontal fan coil units. Since the chilled water system is shut down during winter, cooling is not available during marginal weather, causing further discomfort. The replacement of the existing systems by an integrated heating and cooling system should be considered.

c. The automatic control system in the building has been repaired on an as needed basis at times by using spare parts that are not fully compatible. In certain instances, the system has been disconnected due to lack of parts. The control system is very difficult to operate and maintain in

proper operating condition. The entire control system should be completely upgraded.

d. When a basewide EMCS system was installed at Fort Belvoir, the hospital was connected to this system. Since then all points have been disconnected due to the unsatisfactory operation of the system. Based on experience, it can be said that when old controls are hooked up to an EMCS system, less than satisfactory operation results as many controls are not compatible with the EMCS system. We recommend that only after upgrading these controls the HVAC equipment be hooked up to the EMCS system.

e. In discussions with the maintenance personnel, it has been noted that Blower No. 4 has been operating unsatisfactorily. The blower is approximately forty years old and in poor condition. Replacement parts are not available. It should be considered for replacement.

f. The lighting in the hospital has been upgraded in increments and appears to be in good condition. There are some areas that do not have separate night lighting. Consider providing night lighting.

g. The steam usage in the building is currently unmetered. Consider installing a steam meter.

In order for the mechanical and electrical systems to provide reliable operation, it is recommended that the original heating system installed in 1953 should be considered for replacement. The systems installed subsequently should be evaluated and retrofitted to provide general upgrading. Incorporating the recommended ECOs and some of the other

ECOs included in this report will result in energy efficient and reliable mechanical and electrical systems.

APPENDICES

SCOPE OF WORK

FUEL RATES

EXHIBITS

SCOPE OF WORK

Scope of Work

Energy Savings Opportunity Survey
Energy Engineering Analysis Program
Dewitt Army Hospital
Fort Belvoir, Virginia

During the pre-negotiation meetings, the following items were discussed and agreed to form the basis of this report:

1. The A/E will review the pre-final report submitted by NUS.

2. The A/E will prepare a baseline energy consumption for the hospital using Carrier's E20-II program.

3. The A/E will visit the site with the objective of noting any changes to the building and for including in the calculations for baseline energy calculations.

4. The NUS report has fourteen ECOs recommended for implementation. The A/E will revalidate these.

5. The A/E will perform computerized calculations for the recommended ECOs with the exception of ECO-M4 which will be manually calculated. ECO-E1 will be evaluated by using a program developed by EAC by using a spreadsheet format similar to Lotus 1-2-3.

6. The A/E will revalidate the cost estimates for the recommended ECOs to FY 1993.

7. For the remaining ECOs, the A/E will escalate the original construction and energy costs to FY 1993.

8. The EMCS at the hospital is presently not functioning due to disconnection of many points. The A/E will base calculations on the current operating procedures.

9. After evaluating the fourteen ECOs recommended by NUS, the A/E will prepare a pre-final submittal. The submittal will list all the ECOs recommended by the A/E. The report will summarize energy savings in Mbtu,

investment cost, first year savings in dollars, SIR and payback period.

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The numbers assigned to ECOs by NUS were changed in the EAC report to list ECOs numerically by descending value of SIR.

EAC - ESOS REPORT - '91
NUS - ESOS REPORT - '85

1.5 ENERGY CONSERVATION ANALYSIS:

1.5.1 ECO's Investigated:

Following is a list and a description of all the ECO's Investigated:

ECO-A1 - Add insulation to walls of existing 1953 building. The original building wall construction did not include insulation.

SEE EAC ECO-A2

ECO-A2 - Add insulating sash to windows that do not have insulating windows (approximately 5% of all windows).

SEE EAC ECO-A1

ECO-A3 - Caulk and weatherstrip existing windows and doors.

SEE EAC ECO-A3

ECO-A4 - Insulate the ceilings located above steam "PRV" stations. Temperature of floor above the PRV station measured at above 90°F causing discomfort and wasted cooling energy.

SEE EAC ECO-A4

ECO-A5 - Add roof insulation sufficient to provide conformance with DOD criteria.

SEE EAC ECO-A5

ECO-A6 - Add sealing at the loading docks to reduce heating requirements during extended periods of loading and unloading.

"NO OVERHEAD DOORS TO SEAL" NUS

ECO-M1: Chiller Revisions:

This measure evaluates the modification of the water chilling equipment (primary and critical) for improved air conditioning efficiencies. In order to optimize the extent of modification, the most cost effective of the following options will be selected to represent the measure:

"ECO-M1c IS THE MOST COST-EFFECTIVE OPTION — NUS"

1. ECO-M1a - Remove the existing primary chillers and install new high efficiency (low KW/ton) chillers.

2. ECO-M1b - Remove the existing primary and install new high efficiency chillers sized to handle both primary and critical loads. Critical chiller shall be used on a standby basis only.

3. ECO-M1c - Retrofit a variable frequency modulator for capacity reduction on the existing chillers in lieu of the less energy efficient vane control.

   SEE EAC ECO-M6

4. ECO-M1d - Similar to M1a, but with the additional feature of a frequency modulator.

5. ECO-M1e - Similar to M1b, but with the additional feature of a frequency modulator.

ECO-M2: Chilled Water Distribution Modification:

Convert the chilled water distribution from one of constant flow/variable return temperature to variable flow/constant return temperature utilizing primary/secondary pumping. This may be accomplished by some central plant repiping, adding pumps and closing off the normally open port of the

3-way control valves. Care should be taken to analyze the hydraulics and design modification to (1) prevent the resulting head pressure differential from exceeding the rated differential close-off ratings of the valves and (2) maintain sufficient number of 3-way control valves to prevent dead heading at the secondary pumps. Once the conversion is accomplished, the operating engineers will be able to deactivate equipment during off-peak periods and closely match the central heat transfer and distribution equipment with cooling requirements of the building.

SEE EAC ECO-M 7

ECO-M3: Chilled Water Reset:

Install a system of sensors and controllers that will allow resetting of chilled water supply temperature as high as possible without loss of proper dehumidification.

SEE EAC ECO-M 8

ECO-M4: Two-Speed Motor on Cooling Towers:

Provide two-speed motors to allow the plant to reduce fan energy costs during off-peak conditions.

SEE EAC ECO-M 9

ECO-M5: Lower Condenser Water Temperature:

Revise the cooling tower and condenser water control to maintain 65°F. The lower condenser water temperature decreases operating KW/ton due to the increased log mean temperature difference between the condenser water and refrigerant.

SEE EAC ECO-M 10

ECO-M6: Condenser Water Distribution Modification:

Provide 2-position remotely controlled butterfly valves to isolate sections of cooling towers during off-peak periods. This will prevent excessive condenser water flow, allow the operating engineers to optimize condenser water flow during peak periods and provide lower condenser water temperatures at a given wet bulb temperature. Thus, the cooling towers will provide the lower temperatures indicated above in ECO-M5, at less energy.

SEE EAC ECO-M 19

ECO-M7: Revise Steam Heating System:

Replace the existing steam perimeter heating system installed in the original 1953 building with a new hot water perimeter system. The existing system is controlled by outside air temperatures, thus providing uneven temperatures. There is evidence of increasing maintenance with steam traps leaking and condensate piping deteriorating. The placement of individual control valves at the perimeter was considered, but experience indicated retrofit on 30-year old steam systems (especially condensate piping) required extensive piping replacement. Therefore, this measure will analyze the cost effectiveness of complete replacement.

SEE EAC ECO-M 11

ECO-M8: Reduce Outside Air Quantities:

Existing air handling systems appear to utilize greater minimum outside air levels than code or exhaust air balance requirement. This measure will analyze those systems for extent of energy savings along with affect on current hospital operations.

SEE EAC ECO-M 2

ECO-M9: Reduce Supply Air Quantities:

Existing air handling systems appear to be supplying air quantities in excess of that required for code and/or heating and cooling. Those systems will be analyzed for air flow reduction and affect on hospital operations.

ECO-M10: Patient Room Systems:

SEE EAC ECO - M2

Replace existing air handling system serving patient floors. The new system will consist of a VAV central air handling unit located on the roof of each wing, new main duct risers, and duct distribution on each floor, and VAV boxes with minimum air supply arrangement. For each room, control of room temperature will be accomplished with summer/winter thermostat controlling the VAV boxes and perimeter heating control valves. The new system can be implemented in phases to minimize disturbance to the hospital operation.

ECO-M11: Automatic Shutoff Dampers:

SEE EAC ECO - M12

An air handling unit serving areas of varying occupancy periods may be provided with two position dampers to allow isolation of areas during unoccupied periods. This measure reduces air handling, heating, and cooling energy. There are several units at the hospital that are in this category for potential energy savings.

"AFTER CAREFUL REVIEW OF DRAWINGS AND OPERATIONS, NOT A PREFERRED WAY TO CUT ENERGY CONSUMPTION" – NUS

ECO-M12: Economizer Cycle on AHU-10 and 11:

AHU's 10 and 11 were installed with economizer capabilities (100% OA, free cooling), but due to air stratification and no preheat coil chilled-water coil freezes up, therefore the hospital staff has blocked-off the outside air intake. This blockage prevents the use of outside air for cooling, thus the critical chillers operate all year. This ECO will analyze the energy savings and construction of installing means to prevent stratification and allowing the economizer operation to be activated.

ECO-M13: Heat Recovery - Condenser Water:

SEE EAC ECO - M13

Provide heat recovery system from kitchen refrigerator condenser water system. This measure will include adding a heat exchanger in the condenser water piping to provide domestic hot water before discharging the warm condenser water to the existing outdoor cooling tower. Energy savings will occur by (a) reclaiming heat rejected by the refrigerators and (b) reducing the hours of operation of the cooling tower fan motor.

NOT DEVELOPED BY NUS

ECO-M14: Exhaust Air Heat Reclaim:

Provide run-around heat reclaim systems to capture heat from the critical area exhaust plus the exhaust fans located in the seventh floor machine room and preheat the comparable outside air quantity on a large air handling unit.

SEE EAC ECO - M5

ECO-M15: VAV Conversion:

Replace the existing constant volume reheat air handling system, serving the first floor outpatient area, with new VAV system including rezoning. The new VAV system will be of minimum air supply arrangement to meet ventilation code requirement. The existing system uses return air thermostats modulating reheat coil control valves to maintain each zone temperature. The system wastes energy by cooling and then reheating the supply air. The new system will reduce the energy required by (a) reducing the reheat and (b) reducing motor energy due to reduced air supply quantity.

SEE EAC ECO-M14

ECO-M16: Multizone Zone Demand Reset:

Provide system of controls on all multizone units to reset hot and cold deck temperatures based on zone calling for the greatest demand. This measure reduces the average hot and cold deck temperature differential, thus reducing energy losses through damper leakage.

SEE EAC ECO-M3

ECO-M17: Reheat Zone Demand Reset:

Provide zone demand reset for all reheat systems utilizing a constant discharge temperature controller. This will minimize the summer off-peak and intermediate season cooling energy use.

"NOT APPLICABLE" - NUS

ECO-M18: Dead Band:

Modify the existing controls on all units with a single controller operating both chilled water valves and heating valves, in sequence. The modification to consist of providing a dead band between the spring ranges of the heating and cooling control valves to prevent an overlap of heating and cooling during intermediate seasons.

SEE EAC ECO-M20

ECO-M19: Enthalpy Control:

On all systems equipped with economizer cycle controls, provide enthalpy controllers to determine periods of economizer cycle operation in lieu of the existing outdoor air thermostat. This method of control will allow the system to maximize the energy savings for economizer operation. This is accomplished by comparing the total heat content of both return and outside air and actuating dampers to utilize the source of least heat content for cooling.

NOT ADMISSIBLE - ARMY REG.

ECO-M20: Night Set-Back:

Provide night set-back controls that will automatically reduce the space temperature by 15°F during unoccupied periods for the heating season. The periods of set-back would be programmed into the EMCS.

SEE EAC ECO-M1

ECO-M21: EMCS Interface:

The hospital is currently undergoing connection to the basewide EMCS system. This capability allows the potential for shutdown of unoccupied areas. This ECO will evaluate the proposed sequence of operation and deter-

mine whether it is consistent with building occupancy and maximize (within hospital operations) the potential for shutdown.

EMCS NOT IN OPERATION

ECO-M22: Load Shedding:

This ECO will evaluate the feasibility of programming the EMCS to cycle equipment and limit demand during anticipated periods of high electrical energy use. This project does not save energy, but since a ratchet exists that carries over to other times of the year, this measure could result in considerable cost savings.

EMCS NOT IN OPERATION

ECO-M23: Repair Controls:

Much of the control tubing contains oil and moisture and the resulting inaccuracies and lack of response is causing over compensation and excessive use of energy. This ECO will analyze the improved controlability and associated reduction in energy use by blowing out the control tubing with nitrogen.

A MAINTENACE MEASURE

ECO-M24: Two-Speed Motors on OR Unit:

Change motors of operating rooms air handling unit system to two-speed. Lower speed to be used during non-occupied times. The present system air supply is designed for 25 air changes per hour. This allows the reduction of the outside air on the system. The higher air quantity requires two larger motor sizes. During non-occupied times, 15 air changes per hour and 75% recirculation is permitted by Army Facilities Design Guide. Since the operating rooms are only occupied 50% of the time, the system can operate on reduced air flow resulting in reduction of electrical energy consumption.

ECO-M25: Heat Trace Domestic Hot Water:

AN ALTERNATIVE PREFERRED METHOD IS ANALYZED AS EAC ECO-M2

The domestic hot water system constantly recirculates water to prevent a time lapse of hot water availability to the user. This could also be accomplished by heat tracing the supply piping to prevent a drop in hot water below 105°F. This measure will analyze the cost effectiveness of providing heat tape and shutting off the recirculation pumps.

ECO-M26: Water Treatment:

SEE EAC ECO-M16

The condenser water system water treatment has been deactivated. Provide automatic monitoring and controlled feed water treatment system for the cooling towers. This will greatly reduce tube fouling and improve heat transfer capabilities of the chillers.

SEE EAC ECO-M17

ECO-M28: Insulation:

Provide insulation on all hot water storage tanks.

SEE EAC ECO-M18

ECO-M29: Kitchen Hood:

Provide a special energy conserving type kitchen hood, especially designed to meet code capture requirements but at a reduced supply air quantity.

PHYSICAL CONSTRAINTS AT THE FACILITY, AND PROXIMITY OF WINDOWS AND ENTRANCE NEAR AIR INTAKE PRECLUDES THE PRACTICABILITY OF THIS ECO.

ECO-M30: Kitchen Hood Shutdown:

Modify control of kitchen HVAC system to allow hood shutdown during unoccupied periods.

PRESENTLY IMPLEMENTED

ECO-M31: Steam Shutoff:

Provide an automatic steam shutoff valve and control for steam kitchen equipment.

"OPTION DISCARDED" – NUS

ECO-E1: Replace Existing Incandescent Lamps with Energy Efficient 34 Watt Fluorescent Lamps:

The existing main hospital building is lighted using approximately 60 percent fluorescent fixtures and 40 percent incandescent fixtures. Recent lighting improvement contracts will further increase the quantity of fluorescent fixtures but approximately one-third of the hospital will remain incandescent.

The standard hospital fluorescent replacement lamp is the energy efficient 34 watt lamp. This lamp provides an energy savings for each lamp replaced of approximately 9 percent.

As an additional energy conservation measure, replacement of the remaining incandescent fixtures is necessary. Most incandescent lamps presently used in the hospital are either 100 watts or 150 watts. To obtain the same relative lighting levels using fluorescent lamps, the savings in watts per fixture would be approximately 32 watts for the 100 watt fixtures and approximately 65 watts for the 150 watt fixtures.

SEE EAC ECO-E4

ECO-E2: Replace Standard Ballasts with Energy Saving Ballasts:

The existing fluorescent lighting fixtures are equipped with standard ballasts. Replacement ballasts stocked by the hospital are also of the standard type. Energy saving ballasts for fluorescent fixture containing two lamps can save an additional 10 percent over the savings obtained using reduced wattage lamps.

Since the normal failure rate for fluorescent ballasts is approximately 10 percent per year, normal maintenance replacement with energy saving ballasts would extend replacement over many years. A complete replacement of all ballasts should be scheduled for a period not to exceed three years to obtain a good return on the investment.

SEE EAC ECO-E5

ECO-E3: Infrared Switching of Lighting Fixtures:

Recent studies of office building occupancies have indicated that offices and similar use areas are unoccupied for over 50 percent of the working day. An infrared sensor lighting control system provides lighting in an area only when the area is occupied. Lighting control of this type can be used to control fixtures in individual offices or in small areas of large open offices.

SEE EAC ECO-E6

The infrared sensor detects occupancy of an office by sensing the body heat of the occupant. When the person leaves the office a timer shuts off the lighting after a predetermined time. Specific areas in large open office can be controlled in the same manner.

ECO-E4: Photocell Control of Lighting Fixtures:

During daylight hours the footcandle level in many offices is quite high and room lighting adds very little to the room lighting level. Using photocell control, dimming the lighting fixture or turning off the lighting fixture is possible. Another use of photocell fixture control would be for control of perimeter lighting in large open office areas. Interior areas of large open office areas would require more artificial lighting than the perimeter areas and, therefore, would not benefit from the photocell control system.

SEE EAC ECO-E7

ECO-E5: Programmable Time Control of Lighting Fixtures:

The flexibility of programmable controllers makes this ECO attractive for areas such as administration, outpatient and unused hospital areas. Lighting levels could be controlled to provide for janitorial lighting level, security lighting level or weekend and holiday lighting level. Control of the selected areas can be accomplished automatically and have a manual override for occupancy outside of the normal hours.

SEE EAC ECO-E3

ECO-E6: Energy Efficient Motors:

The replacement of the existing electric motors with motors having a higher efficiency can provide a substantial electric energy savings. Although the improvement in efficiency is only a small percentage improvement, large motors and motors that run constantly can amortize the replacement cost in a relatively short time. For smaller motors, the cost of replacement requires a longer amortization period.

SEE EAC ECO-E8

ECO-E7: Variable Speed Motor Control:

Fan motors, pump motors and similar use motors are usually oversized for the loads encountered. The efficiency and power factor for oversized motors is low. Variable speed controllers improve the operating efficiency of motors and power factors and at the same time limits the starting inrush current to a value as low as 25 percent of the normal.

SEE EAC ECO-M6

ECO-E8: Power Factor Improvement:

Power factor records for the Hospital facility are not maintained. However, an overall base powerfactor record is available from the utility company. The utility company records indicate that the base powerfactor varies from approximately 96 percent during period of low electrical usage to 90 percent during periods of higher usage. Capacitors have been installed on the base distribution circuits for the base powerfactor improvement.

SEE EAC ECO-E9

ECO-E9: Controlled Elevator Operation:

A relatively substantial amount of the facility energy budget is needed for operation of the elevators due to the large elevator motor horsepower and the frequent starting required for this type of motor.

Shutdown of selected elevators during non-peak visiting hours will be recommended. The cost to implement this ECO will be zero.

SEE EAC ECO-E10

ECO-E10: Reduction of the Peak KW Demand:

Electrical energy peak KW demand for the base could be reduced up to 700 KW per month by using the facility emergency generators during periods of peak demand. The cost of operating the emergency generators, maintenance of the equipment, and the projected life expectancy of the equipment must be deducted from the KW demand savings.

SEE EAC ECO-E1

Virender Puri to DeWitt File

The numbers assigned to ECOs by NUS were changed in the EAC report to list ECOs numerically by descending value of SIR.

2.13.1 SUMMARY TABLE, ALL ECO's ANALYZED by NUS
(Table taken from NUS Report)

EAC ECO #	NUS ECO #	(1)Cost($)	Annual Energy Saving (MBTU)	First Year Cost Saving ($)	SIR	Feasible
A-2	A1	40,110	122	768	0.24	No
A-1	A2	4,410	103	604	1.73	Yes
A-3	A3	31,640	232	1,551	0.63	No
A-4	A4	21,420	27	47	0.02	No
A-5	A5	406,040	890	4,720	0.15	No
	A6	THIS PROJECT WAS FOUND TO BE INAPPLICABLE				
M-6	(2)M1a thru e	11,870	1,707	2,987	2.46	Yes
M-7	M2	29,400	1,402	2,453	0.81	No
M-8	M3	3,260	261	457	1.37	Yes
M-9	M4	10,710	164	286	0.26	No
M-10	M5	3,260	2,324	4,067	12.19	Yes
M-19	M6	13,020	543	950	0.71	No
M-11	M7	278,040	155	5,311	0.13	No
M-2	M8&M9	50,400	17,720	59,336	13.80	Yes
M-12	M10	484,890	11,808	53,722	1.36	Yes
	M11	NOT RECOMMENDED SEE VOLUME 4 ECO ANALYSIS				
M-13	M12	6,510	920	1,610	2.41	Yes
	M13					
[illegible]-5	M14	20,900	447	3,617	2.25	Yes
M-14	M15	128,200	4,982	19,368	1.82	Yes
M-3	M16	10,400	165	1,097	1.35	Yes

(1) Construction Cost + SIOH
(2) Only M1c is cost effective

EAC ECO #	ECO #	[1] Cost ($) Construction	Annual Energy Saving (MBTU)	First Year Cost Saving ($)	SIR	Feasible
	M17	NOT RECOMMENDED, SEE VOLUME 4 ECO ANALYSIS				
M-20	M18	1,190	16	80	0.84	No [a]
	M19	11,120	648	884	0.78	No
M-1	M20	SEE VOLUME 4 ECO ANALYSIS				
	M21&M22	SEE VOLUME 4 ECO ANALYSIS [b]				
	M23	SEE SECTION 2.9 OF VOLUME 2 [c]				
M-2	M24	NOT RECOMMENDED, SEE VOLUME 4 ECO ANALYSIS				
M-16	M25	NOT RECOMMENDED, SEE VOLUME 4 ECO ANALYSIS				
M-17	M26	3,710	488	1,153	2.99	Yes
	M27	5,250	258	1,765	4.31	Yes [d]
M-18	M28	1,680	390	2,669	20.38	Yes
	M29&M30	69,720	2,476	16,958	3.12	Yes [e]
	M31	NOT RECOMMENDED, SEE VOLUME 4 ECO ANALYSIS				
E-4	E1	80,540	3,864	60,697	0.48	No
E-5	E2	58,700	559	2,533	0.22	No
E-6	E3	18,170	1,451	4,807	0.79	No
E-7	E4	7,250	461	876	0.64	No
E-3	E5	98,180	1,666	2,993	0.17	No
E-8	E6	48,770	3,743	3,838	0.77	No
M-6	E7	SEE VOLUME 4 ECO ANALYSIS				
E-9	E8	SEE VOLUME 4 ECO ANALYSIS				
E-10	E9	SEE VOLUME 4 ECO ANALYSIS				
E-1	E10	5,250	NONE	-2,610	-4.26	No

(1) Construction Cost and SIOH

a) Not applicable per Army Regulations.
b) EMCS not in operation.
c) A maintenance measure. Some work has been done.
d) No calculations found in the report.
e) Physical constraints in the building do not permit implementation.

FUEL RATES

Engineering
Applications
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EAC STANDARD FORM
July 1985

TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 664-5256 Date 1/3/91

To MR MIKE SMITH ABOUT COST TO GENERATE STM @ BLDG 1442 332 Time

Discussion 12/31 1:00 NOT IN

1/2 10:00 BUSY SIGNAL, 10:15 ", 10:20 ", 10:30 ", 10:50 LEFT MESS to CALL

1/3 11:15 MIKE CALLED & SAID THAT THE STEAM COST WHICH FT BELVOIR CHARGES CLIENTS WHO USE STEAM IS BASED ON COMBINED OPERATION & MAINTAINENCE FIGURES FOR ALL BASE CENTRAL HEATING PLANTS. AT THIS WRITING FT. BELVOIR IS CURRENTLY CHARGING $9.97 / 1000 lbs OF STEAM.

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

I. APPLICABILITY

This schedule is applicable to any Federal Government installation contracting for 1500 kW or more of alternating current electricity. Such installation served under this schedule may change to service under the Company's Schedule No. 6 - Large General Service, and vice versa, effective with the meter reading date immediately preceding the receipt by the Company of the Government's written request for such change, if (1) the initial term of the applicable schedule has been satisfied; or (2) a change is made in the rate for service under either schedule. However, when an installation makes such change, the installation must remain on the then-selected schedule for at least one year after the change is made, regardless of changes in either rate schedule during such one-year period, other contract provisions to the contrary notwithstanding.

II. SERVICE AVAILABLE

The Company will supply the equipment necessary and will deliver to the Customer at a delivery point mutually satisfactory to the Customer and the Company, 60 hertz alternating current electricity of the phase and Company standard nominal voltage desired by the Customer at said delivery point, provided electricity of the phase and voltage desired by the Customer is available generally in the area in which electricity is desired.

III. 30-DAY RATE

A. KW Demand Charge		
First 1500 kW of Demand or Less		$16,683.78
Additional kW of Demand	@	$ 10.78 per kW
B. Plus rkVA Demand Charge	@	$ 0.15 per rkVA
All rkVA of Demand		
C. Plus Energy Charge		
All kWh	@	2.165¢ per kWh

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

D. Annual Fuel Adjustment Factor

1. The kilowatthours in each customer's bill for the current billing month shall be multiplied by an annual fuel adjustment factor which shall be equal to the sum of:

   (a) the estimated current-period fuel adjustment factor, and

   (b) the prior-period deferral adjustment factor.

2. The estimated current-period fuel adjustment factor to become effective with the April billing month of each year shall be based on the total estimated system fuel expenses allocable to Schedule MS and Schedule MS kilowatthour sales for the 12-month period beginning in April of each year, and shall be calculated by the fuel adjustment factor formula shown below rounded to the nearest thousandth of a cent.

3. The prior-period deferral adjustment factor to become effective with the April billing month of each year shall be based on the difference between the total fuel expenses (using the criteria outlined in (a) through (c) of paragraph 7. below) allocable to Schedule MS and the total fuel recoveries by Schedule MS customers for the 12 months prior to April of each year, divided by the estimated Schedule MS kilowatthour sales for the 12-month period beginning with April of each year (6 months where a semi-annual change is made pursuant to paragraph 5. below). The prior-period deferral adjustment factor will be adjusted for taxes.

4. The intent of the annual fuel adjustment factor is to recover all fuel expenses allocable to Schedule MS customers. To the extent the amount recovered from Schedule

(Continued)

III. 30-DAY RATE (Continued)

MS customers through annual fuel adjustment factors and the fuel component of the base rate exceeds the cost of fuel allocable to Schedule MS for the same time period, this over-recovery shall be a credit in the calculation of the prior-period deferral adjustment factor for the 12-month period beginning with the next April. To the extent the amount recovered from Schedule MS customers through the annual fuel adjustment factor and the fuel component of the base rate is less than the cost of fuel allocable to Schedule MS for the same time period, this under-recovery shall be a charge in the calculation of the prior-period deferral adjustment factor for the 12-month period beginning with the next April.

5. The annual fuel adjustment factor shall be reviewed on a semi-annual basis to determine if any change is required. The current and prior period portions of the fuel adjustment factor will be reviewed individually, and a change to one or both may be made. The adjustment may be deferred until the end of the 12-month period, provided the net difference between the Company's actual and estimated under-recovery at the end of the 12-month period is no greater than seven and one-half per centum of actual and estimated fuel expenses or the net difference between the actual and estimated over-recovery at the end of the 12-month period is no greater than five per centum of actual and estimated fuel expenses.

6. Fuel adjustment factor formula:

$$F = \left[\frac{(E_1 + E_2) - B}{S} \right] (T)\ (100)$$

Where:

F = Estimated fuel adjustment factor in cents per kilowatthour.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

E_1 = Estimated North Anna fuel expenses plus estimated Old Dominion Electric Cooperative Buyback fuel expenses allocated to Schedule MS Customers.

E_2 = Estimated total fuel expenses less estimated North Anna fuel expenses and Old Dominion Electric Cooperative Buyback fuel expenses allocated to Schedule MS Customers.

S = Estimated total Schedule MS kilowatthour sales for the 12-month period beginning with April each year.

B = Base cost of fuel per kWh sold adjusted for line loss.

T = Adjustment for state and local taxes measured by gross receipts: 100% divided by (100% minus applicable gross receipts tax rate).

7. The estimated fuel expenses allocable to the Schedule MS Customers for 12-month period beginning April of each year, determined as follows:

(a) Fossil and nuclear fuel consumed in the Utility's own plants, and the Utility's sharge of fossil and nuclear fuel consumed in jointly owned or leased plants.

The cost of fossil fuels shall be those items initially charged to account 151 and cleared to accounts 501, 518 and 547 on the basis of fuel used. In those instances where a fuel stock account (151) is not maintained, e.g., gas for combustion turbines, the amount shall be based on the cost of fuel consumed and entered in account 547.

The cost of nuclear fuel shall be the amount contained in account 518 except that if account 518 also contains any expense for fossil fuel which has already been included in the cost of fossil fuel, it shall be deducted from this account.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

Plus

(b) The following purchased power costs:

(i) The fuel cost component of any purchased power transaction.

or

(ii) The total energy charges associated with economic purchases if the energy charges are less than the Company's total avoided variable costs during the purchase period.

or

(iii) The total expense associated with purchased power of less than twelve months duration if the total cost of the purchase is less than the Company's total avoided variable costs and if the purpose of the purchase was solely to displace higher cost generation. Purchases made to solely displace higher cost generation exclude reliability purchases. A purchase shall be deemed for reliability where the Company's system reserve criterion is not met. Such criterion is as follows:

Operating Reserve (consisting of largest generating unit plus regulating margin plus load forecast margin)

Minus

75% of Emergency Contract Capacity

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

III. 30-DAY RATE (Continued)

Equals

Spinning Reserve Requirement

(iv) Energy receipts that do not involve money payments such as Diversity Energy and pay-back of Storage Energy are not defined as Purchased or Interchanged Power relative to the Fuel Clause.

Minus

(c) The cost of fossil and nuclear fuel recovered through inter-system sales including the fuel costs related to economy energy sales and other energy sold on an economic dispatch basis.

Energy deliveries that do not involve billing transactions such as Diversity Energy and pay-back of Storage Energy are not defined as sales relative to the Fuel Clause.

IV. DISCOUNTS

Discounts will apply only to charges under Paragraphs III.A. and C. for services with delivery voltages of 69 kV or higher.

A. KW Demand Discount
All kW of Demand @ $0.66 per kW Discount

B. Energy Charge Discount
Energy Charge @ 2.0% Discount

V. MINIMUM CHARGE

The minimum charge shall be such as may be contracted for but not less than the sum of the charges in the 30-Day Rate Paragraph III.A. and B. including applicable discounts in Paragraph IV.A. This includes no allowances of energy, and all energy used shall be paid for in addition

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

V. MINIMUM CHARGE (continued)

at the above rates. Such minimum charge shall be increased in the amount of the applicable fuel adjustment under Paragraph III.D.

VI. OTHER PROVISIONS

A. Determination of kW Demand

The kW of demand billed under Paragraph III.A. shall be the highest of:

1. The highest average kW measured at this location in any 30-minute interval during the on-peak hours of 7:00 a.m. to 10:00 p.m. Mondays through Fridays, plus 30% of the excess of this amount determined in a similar manner during any other period during the current billing month, or

2. 90% of the highest kW of demand at this location as determined by Subparagraph VI.A.1., above during the billing months of June through September of the preceding eleven billing months, or

3. 50% of the kW of demand contracted for under Paragraph VII., or

4. 1500 kW.

B. Determination of rkVA Demand

The rkVA of demand billed shall be the highest average rkVA measured in any 30-minute interval during the current billing month.

C. Meter Reading and Billing

When the actual number of days between meter readings is more or less than 30 days, the kW Demand Charge, the rkVA Demand Charge, the charge per kW of contracted demand in Paragraph VIII.C., and the minimum charge of the 30-day rate will each be multiplied by the actual number of days in the billing period and divided by 30.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

VI. OTHER PROVISIONS (continued)

D. Late Payment Charge

A late payment charge of one percent (1%) per month will be applied on all amounts that remain unpaid on the Company's books on the next billing date.

VII. DETERMINATION OF CONTRACT DEMAND

The contract demand under this schedule shall be the maximum number of kW which the Company is to supply. Contract demands may be changed by mutual agreement as to amount of change and term of agreement.

VIII. BREAKDOWN, RELAY OR PARALLEL OPERATION SERVICE

Breakdown, relay or parallel operation service may be contracted for under this schedule under the following conditions:

A. Suitable relays and protective apparatus shall be furnished, installed, and maintained at the Customer's expense in accordance with specifications furnished by the Company. The relays and protective equipment shall be subject, at all reasonable times, to inspection by the Company's authorized representative.

B. The contract demand to be billed under this Paragraph VIII. shall be the maximum number of kW which the Company is to supply. Contract demands may be changed by mutual agreement as to the amount of change and term of agreement. In case the maximum measured kW demand exceeds the contract demand, the measured demand becomes the contract demand for that month and for the next succeeding eleven months.

C. When breakdown, relay or parallel operation service is furnished, the 30-Day Minimum Charge for electricity supplied under this schedule shall be not less than $10.78 per kW of demand contracted for under Paragraph VIII.B. plus any positive fuel adjustment charge under Paragraph III.D.

(Continued)

SCHEDULE MS
FEDERAL GOVERNMENT INSTALLATIONS

(Continued)

IX. SCHEDULE TERMINATION, MODIFICATION OR REVISION

Whenever the Federal Energy Regulatory Commission shall permit a change in the rates set forth in the Company's Schedule RS - Resale Service to Municipalities and Private Utilities - to take effect, this rate schedule shall on the same effective date be modified so as to produce from the Federal Government customers served hereunder the same rate of return as the rates thus permitted to become effective for Schedule RS customers, utilizing for that determination the same ratemaking methodology and test period as used in determining the RS rates. Pending final decision by the FERC, the Federal Government would pay a rate as initially proposed by the Company after the suspension period, if any, subject to refund after final decision of any excess payments plus interest at the rate as authorized by the FERC. This method of determining a rate for the Federal Government customers will continue in effect indefinitely; provided, however, that either party may terminate this method of rate determination by giving six months' notice. Should such a termination occur, the parties, if appropriate, would negotiate a new rate in good faith.

X. TERM OF CONTRACT

The term of contract for the purchase of electricity under this schedule shall be such as may be mutually agreed upon, but for not less than one year.

SCHEDULE MSSG
FEDERAL GOVERNMENT INSTALLATIONS
(STANDBY GENERATOR - EXPERIMENTAL)

I. APPLICABILITY

This schedule is applicable on a voluntary, experimental basis to any Federal Government installation that: (1) contracts for 1500 kW or more of alternating current electricity under Schedule MS - Federal Government Installations or Virginia jurisdictional Schedule 6 - Large General Service and (2) has standby generation capacity of 150 kW or greater. Under this schedule the Customer agrees to transfer load normally served by the Company to his standby generation upon Company request. Standby generation is defined as generation installed by the Customer to supply electricity primarily during those times when service is not available from the Company. The Customer may operate generation in parallel with the Company provided that any operation, outside of requested operation, is limited to no more than 10 percent of the hours in any billing month of the year.

II. STANDBY GENERATOR OPERATION

A. The Company may request operation of the Customer's standby generator only from December 1 through March 31 (Winter) during the hours between 6 a.m. and 12 noon, weekdays, or from June 1 through September 30 (Summer) during the hours between 2 p.m. and 8 p.m., weekdays.

B. Company requested operation of the Customer's standby generator will be limited to a maximum of 200 hours per year, 125 hours per season, and once per day.

III. NOTIFICATION

A. The Company will provide no less than 4 hours notice of requested operation of the Customer's standby generator.

B. A notification procedure shall be established which is mutually agreeable to the Customer and the Company. In the event that the Customer is unable to receive notification, due solely to circumstances attributable to the Customer, notification shall be deemed received by the Customer.

(Continued)

SCHEDULE MSSG
FEDERAL GOVERNMENT INSTALLATIONS
(STANDBY GENERATOR - EXPERIMENTAL)
(Continued)

IV. DETERMINATION OF PAYMENT TO CUSTOMER

A. For each season the Customer shall contract for the amount of load the standby generation will maintain upon Company requested operation. This amount shall be based on the kW output of the Customer's standby generator, and shall be referred to as the capacity level (CL). Summer CL need not equal Winter CL. Both shall be mutually agreeable to the Customer and the Company, but no greater than the load connected to the Customer's generation.

B. For the billing months of May through October, the Customer shall be paid based on the contracted Summer CL. For the billing months of November through April, the Customer shall be paid based on the contracted Winter CL. Payment will be a deduction from the concurrent Schedule MS or Schedule 6 bill of the Customer. During billing months where operation of standby generation is not requested by the Company, the customer shall be paid $6.00 per kW of applicable contracted CL. For all other billing months the Customer shall be paid $6.00 per kW of Average Capacity Generated during Company requests, but no more than $6.00 times the applicable contracted CL. Average Capacity Generated is defined as the total energy generated during period(s) of Company requested generation during the current billing month, divided by the hours of requested generation during the current billing month. Each season the Customer may request by letter that the hours of one generation request be excluded in the determination of the Average Capacity Generated for a particular billing month.

C. When the Average Capacity Generated for any billing month is less than the applicable contracted CL, payment for the billing month shall be based on the Average Capacity Generated. In addition, the Customer shall reimburse the Company the difference in payments between the current billing month and those previous billing months in the current season where generation was not requested. Contract Summer CL may be increased by mutual agreement subsequent to the October billing month. Contract Winter CL may be increased by mutual agreement subsequent to the April billing month.

(Continued)

SCHEDULE MSSG
FEDERAL GOVERNMENT INSTALLATIONS
(STANDBY GENERATOR - EXPERIMENTAL)
(Continued)

V. BILLING TO THE CUSTOMER

Company owned facilities will be required for this experimental program to meter the output of the Customer's generator and will be provided at no cost to the Customer. The estimated new installed cost of such facilities will be calculated for informational purposes. During the experimental period, the Customer shall not be billed for any costs incurred by the Company due to meter reading, processing or communication. For installations with generator capacity between 150 KW and 249 kW, the Customer will be required to provide for all necessary installation costs associated with the installation of the meter on the generator. For installations with generator capacity of 250 kW or greater and during the first year of this program, the Company will reimburse the Customer for 100 percent of reasonable installation costs associated with the meter installation. After the first year of the program, all new customers requesting service under Schedule MSSG will be responsible for meter installation costs.

VI. METERING AND FACILITY INSPECTION

All facilities necessary to meter the Customer's standby generation shall be installed and maintained according to Company specifications. All electrical facilities on the line side of the metering installation shall be subject to inspection by the Company's authorized representative at all reasonable times.

VII. METER READING AND PAYMENT

Meters may be read monthly. Payments under this schedule will be used to reduce the concurrent Schedule MS or Schedule 6 bill of the Customer.

VIII. TERM OF CONTRACT

The term of contract under this schedule shall be such as may be mutually agreed upon, but for not less than one year.

EXHIBITS

PM

Engineering
Applications
Consultants

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9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

February 16, 1990

Department of the Army
Baltimore District
Corps of Engineers
P.O. Box 1715
Baltimore, Maryland 21203-1715

Attn: Mr. Jim Hawk, CENAB-EN-MN

Re: Energy Survey Fort McNair and Fort Belvoir
A/E Contract No. DACA-31-89-R-045
EAC Project No. 89034.00

Gentlemen:

This has reference to the scope of work for the above project and the computer program to be used for simulation of building energy usage.

We understand that Carrier's E20-II Software Hourly Analysis Program (HAP) (Version 2.0) is acceptable to the Army for simulating buildings for their energy usage pattern since it utilizes the ASHRAE-endorsed transfer function method.

We propose to use the above program, along with Carrier's Advanced Engineering Economic Analysis which incorporates DoD Study Criteria (TM5-802-1), including ECIP, for the referenced project.

We enclose a recapitulation of the telephone conversation with the Carrier's Software Systems Network, regarding the above-mentioned program, for your consideration.

We are submitting this information for your approval. Should you have any questions, please call.

Sincerely,

Virender Puri

Virender Puri, P.E.
President

VP/rc

Enclosure

cc: cc, PM

\a\letters\39034\021690

Engineering
Applications
Consultants

A Professional
Corporation

9004-B Crownwood Ct.
Burke, Virginia 22015-1630
(703) 978-0923

May 4, 1990

Department of the Army
Baltimore District Corps of Engineers
P. O. box 1755
Baltimore, Maryland 21201-1755

Attn: Mr. James Hawk
Project Manager

Re: ESOS Survey, Fort McNair and Fort Belvoir
A/E Contract No. DACA 31-89-C-0198
EAC Project No. 89034.00

Dear Mr. Hawk:

We would like to thank you for your acceptance of the Carrier E-20 program for use on buildings that require computer modelling, as well as for use at DeWitt Army Hospital. E-20 computer software analyzes hourly energy consumption of the building. This is a user friendly program which accomplishes all the major features of the programs outlined in the Scope of Work and is comparable to the Blast program.

We hope that you will be satisfied with the results produced by the program.

Should you have any questions or need additional information regarding this program, please call us.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS

Virender Puri

Virender Puri, P.E.
President

VP/rc

cc: cc, PJ, Jose, PM

\b\89034\letters\050490

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9004-B Crownwood Ct.
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For Beth Dell H +
Ft. Belvoir Studies

MEETING REPORT NO. 1

Project ESOS Survey, Fort Belvoir, Virginia

Contract No. DACA 31-89-C-0198 EAC Project No. 89034.01

Place Virginia Power Company Date: August 24, 1990

Purpose Rate Schedules - Generator & Thermal Storage, Billing Information

Persons Present	Code/Designation	Firm/Agency	Telephone
Ed Cowell	Marketing Services	Virginia Power	(703) 359-3055
Jose Barcia	Engineer	EAC	(703) 978-0923

1. Mr. Barcia explained the purpose of the meeting was to collect appropriate information concerning Fort Belvoir in order to conduct an energy conservation survey.

2. Mr. Cowell explained that after the May 1990 billing, Fort Belvoir is served under a 34.5 kW distribution system from a new substation. Mr. Cowell indicated that the magnetic tape metering has not yet been installed. Therefore, the demand print-outs for this summer are not available. However, he will be able to provide us with the demand totals, but not the 30 minute demand readings for this summer. We will have to use last summer's data.

3. Mr. Cowell presented various rate schedules which may merit further study. Some of these rates are experimental and must be specifically requested by the customer, others are not yet applicable to Federal customers, but they may be in the near future.

4. Currently, Fort Belvoir is served under rate schedule MS - Federal Government Installations. An optional rate for Fort Belvoir is rate Schedule 6 - Large General Service. However, at this time, Schedule MS is better for Fort Belvoir because even though the demand charges in the Schedule MS are larger, the fuel charges are negative. According to Mr. Cowell, the negative fuel charge in Schedule MS should continue even with the present oil situation because Virginia Power's generation is only about 5% with oil.

5. Upon request, they will run a rate comparison between Schedule 6 and Schedule MS. However, Mr. Cowell indicated that he has run comparisons before and his experience is that for most large Federal customers and in particular Fort Belvoir, Schedule MS is better.

6. Schedule 6TS - Thermal Storage is not currently available to Federal Customers, but it will probably be available in the near future. However, Schedule MS can effectively be used with Thermal Storage because of Section VI.A.1. (off-peak demand only billed if it exceeds the on-peak demand, and then only by 30% of the excess).

7. Rate Schedule CS - Curtailable Service is not available to Federal customers at this time. It may eventually be extended to Federal customers in the future. However, Virginia Power has a new experimental rate Schedule 10 - Large General Service which essentially works like a curtailable service except that there are 3 (A, B, C) day classifications with different on-peak charges for each day. When Virginia Power announces that a day is classified as A (no more than 32 days/year) it is up to the customer to cut down on his use or pay the higher energy charges. Mr. Cowell indicated that this rate may be advantageous to Fort Belvoir and may merit some study. This rate is limited to 60 customers, but Mr. Cowell indicated that plenty of customers can still participate.

8. Rate Schedule MSSG - Federal Government Installations (Standby Generator - Experimental) would be applicable to Fort Belvoir if the standby generator capacity is greater than 150 kW. Mr. Cowell felt that this rate could be advantageous to Fort Belvoir. He mentioned that other large Federal customers have taken advantage of this rate. For example, the CIA contracted for 20 MW and got paid $120,000 per month.

9. Mr. Cowell mentioned that for the installation of a generator, the old substation (Hayfield Substation) had provisions (relays, protective equipment, etc.) for parallel operation. However, no provisions for parallel service have been made at the new substation (Belvoir substation).

10. Mr. Barcia indicated that for purposes of EAC's study, generators would be placed at Building 505A (Substation) and also the existing generators at DeWitt Army Hospital could be utilized.

11. Mr. Cowell indicated that under Schedule MSSG, Virginia Power could install separate metering at the site of 505-A and DeWitt to measure the load on the generators. In those cases where Virginia Power required the operation of the generator, the load would be measured at these points and a credit would be deducted from the electric bill. As long as Fort Belvoir met the agreed upon contracted demand, the credit on the bill would be issued every month. The metering equipment would be supplied by Virginia Power and would be installed by Fort Belvoir's designated contractors.

12. Mr. Cowell felt that it would not be advantageous for Woodlawn Village to switch to gas since they are taking advantage of the minimum billing demand in the winter, therefore, paying no demand charges and the energy charge under Schedule MS is only 2.165 cents per kWH.

13. Mr. Cowell suggested that we look into conversion to electric (rather than gas) from those buildings that currently have oil until all the minimum winter kW demand charges are used up.

14. Mr. Cowell provided EAC with copies of the monthly billing demands for 1989 and up to May 1990 for Fort Belvoir, Woodlawn Village, and INSCOM which until May were billed separately and now have been combined into one bill. Mr. Cowell will mail the 30 minute daily demands for last year in the near future.

15. Mr. Cowell does not perform profile analysis for customers or deal with thermal storage. He suggested a meeting with Mr. Gary Hicks for these areas. Mr. Barcia agreed to meet with Mr. Hicks after lunch.

Submitted by: Jose Barcia

JB/rc

cc: cc, PM

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project DeWitt Army Hospital

Contract No. EAC Project No. 89034.02

From Jose Barcia Telephone 664-5256 Date 11/27/90

To Mike Smith Time 2:30 pm.

Discussion Billing for Electric at DeWitt

There are two sub-meters for DeWitt Hospital located at Substation 808, one meter for each transformer

The annual Kwh as per meter readings is as follows: (there is no Kw demand sub-meters):

Meter 1 : 1,620,800 Kwh
Meter 2 : 4,553,600 Kwh

This was for the period between Oct 4 1989 - Oct 1 1990. There were some problems with the transformer # 2 and therefore because of the work that was done, the readings on meter 2 may not be accurate. Therefore, these are the readings for the previous year:

Meter 1 2,529,600 Kwh
Meter 2 1,473,600 Kwh

This was for the period between Oct. 3 1988 - Oct 4 1989. He can get the monthly readings, if required.

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Burke, Virginia 22015-1630
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MEETING REPORT NO. 1

Project ESOS Survey, Dewitt Army Hospital

Contract No. DACA 31-89-C-0198 EAC Project No. 89034.02

Place Dewitt Army Hospital Date: 11/30 - 12/1, 1990

Purpose Summary of Information Gathered from Mr. Al Bassett, Building Engineer, Dewitt Army Hospital, Between 11:30 p.m. on November 30, 1990 and 1:30 a.m. on December 1, 1990

Persons Present	Code/Designation	Firm/Agency	Telephone
Al Bassett	Building Engineer	Dewitt	
Subhash Capoor	Engineer	EAC	(703) 978-0923
Virender Puri	Principal	EAC	(703) 978-0923

1. The lighting and occupancy schedules in the NUS report generally conform to the actual field conditions.

2. There has not been any major addition/replacement of equipment since 1985, except for heat pump units for the pharmacy and CT scanner areas and a larger blower for the laboratory.

3. The fan-coil units on the second, third and fifth floors are connected to Blower-17 and those on the fourth floor to Blower-16. Heating needs of these areas are met by steam baseboard radiation.

4. The building is not being operated under any night-setback controls.

5. The hospital has been hooked to EMCS but is not being operated under its control. All controls have been disconnected.

6. The condenser water temperature has been lowered manually for energy savings.

7. Condenser water is regularly treated manually by a maintenance contractor.

8. The chilled water supply temperature is manually reset between 45 and 50 degrees F.

9. Clock controls and occupancy sensor for lights may be considered in the corridors and toilets, respectively.

10. The building at present has energy saver lamps.

Prepared by: Virender Puri

VP/rc VP

cc: cc, PM

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TELEPHONE CONVERSATION SUMMARY

Project FT. BELVOIR ENERGY SAVINGS OPPORTUNITY SURVEY

Contract No. DACA-31-89-C-0198 EAC Project No. 89034.01

From REF Telephone 301 984 2400 Date 12/20

To TRANE CO. JIM FUSCO Time 9:30

Discussion REF: DEWITT HOSPITAL CHILLER.

ASKED ABOUT ECO'S WITH 360 TON CENTRAVAC CVHE036-4CE-4DE IN PARTICULAR VARIABLE FREQUENCY DRIVES.

JIM SAID TRANE WOULD NOT RECOMMEND THIS ARRANGEMENT SINCE IT CAUSES INCREASED MOTOR HEAT AND LEADS TO MOTOR FAILURE.

YORK MARKETS "TURBO MODULATORS" WHICH WERE INSTALLED ON TWO TRANE CHILLERS AT SIBLEY HOSPITAL AND BOTH FAILED - MODULATOR IDEA WAS ABANDONED.

HE SAID WE COULD CONSIDER RETROFITTING CHILLER WITH AN AUXILIARY CONDENSER WHICH WOULD RECOVER HEAT FOR PREHEATING DOMESTIC HOT WATER OR BOILER MAKE-UP WATER AND AT THE SAME TIME LOWER THE MACHINES KW/TON RATE

HE NEEDS SN OF UNIT AND WILL TALK TO HIS SERVICE DEPT TO GET COST ESTIMATE STARTED FOR AUX. CONDENSER SCENARIO. (CANCELED AS PER SC 12/21)

IN ADDITION, ADJUSTABLE FREQUENCY DRIVE EQUIPMENT IS A SOURCE OF POTENTIAL PROBLEMS WITH HARMONICS IN HOSPITALS AND LABORATORIES WHICH WOULD REQUIRE ADDITIONAL COSTS OF ISOLATION TRANSFORMERS AND INTERNAL LINE FILTER CHOKES WHICH MAY OR MAY NOT SOLVE THE PROBLEM.

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January 2, 1991

Department of the Army
Baltimore District Corps of Engineers
P. O. Box 1715
Baltimore, Maryland 21201-1715

Attn: Mr. James Hawk, Project Manager

Re: Energy Savings Opportunity Survey
Dewitt Army Hospital
Fort Belvoir, Virginia
A/E Contract No. DACA 31-89-C-0198
EAC Project No. 89034.02

Dear Mr. Hawk:

Following is a summary of our various discussions with you regarding this project. The criteria and items listed herein are being utilized to develop this study.

- Construction costs developed by NUS (September 1985) will be used for economic analysis of the recommended ECO's. These costs will be escalated to December 1990 based on Building Cost Index published in ENR.

DECEMBER 24, 1990 INDEX	2719
SEPTEMBER 1985 INDEX	2446

- While developing costs for DD1391, the costs determined as above, will be escalated to program year FY 1993 based on Tri-Service MCP Index. **A copy of the latest edition of Engineer Improvement Recommendation System (EIRS) bulletin is requested.**

- Current energy prices, as obtained from the Post, will be used to develop the ECO's recommended in the NUS report.

- Energy escalation and discount rates contained in ECIP guidance dated April 25, 1988 will be used, as per scope.

- Based on U.S. Army Engineer Division, Huntsville comment #9, Army policy does not permit enthalpy control for economizer cycles. As such, enthalpy control is not being investigated.

- For ECOs that were not recommended by NUS, the energy savings and cost estimates developed by NUS will be used to calculate SIR. The cost estimates will, however, be escalated using Building Cost Index.

- Computer generated energy savings will be used for recommended ECOs **where possible.**

- The ECOs in the original report that have not been developed by NUS will not be evaluated.

- Programming documents will be developed after the review of this report by Baltimore District Corps of Engineers and the hospital personnel.

- Despite repeated attempts, some areas of the building were not accessible. NUS field data was used for simulating energy usage in those areas. These areas are the morgue, post office, operating rooms and OB delivery rooms as well as maternity patient rooms, the chapel and the adjacent library.

Should there be any questions or if you notice any discrepancies, please call us.

Sincerely,

ENGINEERING APPLICATIONS CONSULTANTS, P.C.

Virender Puri

Virender Puri, P.E.
President

VP/rc

cc: cc, PM, SC

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project DeWitt

Contract No. EAC Project No.

From Jose Telephone Date 2/14/91

To Arun Time

Discussion COST OF CLOSED TRANSITION ATS — DeWitt

Cost of ATS for up to 800 Amps : $ 31,000 each

Cost of ATS for 1600 Amps : $ 35,000.

The price is a little high but these have good reliability and they would not see any flickering of light when transfering the load.

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TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir / DeWitt

Contract No. EAC Project No.

From Joe Barcic Telephone 359-3055 Date 3/3/91

To Ed Covell - VA Power Time 11:30

Discussion Stand-By Generation Rate.

Rate MSSG - Applicable to Large Federal Customers

1) Customers such as CIA take advantage of this rate.

2) Key portions of rate:

- The demand generated is calculated as average capacity generated. Therefore it is possible to be below the contracted demand during a billing period if the generation on a previous occasion during the same period had exceeded the contract demand.

  Ex: during June called twice and generates 300 Kw and 350 Kw. The average capacity generated for purposes of payment would be 325 Kw.

- If the demand generated during different billing periods is less than the contracted amount, they pay for the lesser amount and if payment has been made previously on a higher amount, then it is deducted. Example: Called in June and generates 350 Kw called in July and generates 300 Kw. Since they paid 350 Kw in June for July they paid for 300 Kw and deduct the 50 Kw payment.

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July 1985

TELEPHONE CONVERSATION SUMMARY

Project Ft. Belvoir / DeWitt

Contract No. ______ EAC Project No. ______

From Jose Barcia Telephone ______ Date ______

To Ed Covell Time ______

Discussion Con't - Stand by generation rate

- Usually VA. Power notifies by 5 pm. of the previous day in the winter and in the morning (before noon) of the same day in the summer. No less than 4 hours notice

3) At Fort Belvoir, VA. Power would pay for the metering cost for the generator

4) No problem having generators at DeWitt and at Substation 505-A. Would require two sets of meters that would be on magnetic tapes and would be coordinated during meter reading.

5) If the generators run isolated from VA. Power and not on parallel, there is no need for interconnection relays and protective equipment.